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Notice of Allowability	Application No.	Applicant(s)	
	10/071,743	JAYARAMAN ET AL.	
	Examiner	Art Unit	
	Henry S. Hu	1713	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address--

All claims being allowable, PROSECUTION ON THE MERITS IS (OR REMAINS) CLOSED in this application. If not included herewith (or previously mailed), a Notice of Allowance (PTOL-85) or other appropriate communication will be mailed in due course. **THIS NOTICE OF ALLOWABILITY IS NOT A GRANT OF PATENT RIGHTS.** This application is subject to withdrawal from issue at the initiative of the Office or upon petition by the applicant. See 37 CFR 1.313 and MPEP 1308.

1. ☒ This communication is responsive to Amendment of December 6, 2004.
2. ☒ The allowed claim(s) is/are 1-4, 6-14, 16 and 17.
3. ☒ The drawings filed on 08 February 2002 are accepted by the Examiner.
4. ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
 - a) ☐ All b) ☐ Some* c) ☐ None of the:
 1. ☐ Certified copies of the priority documents have been received.
 2. ☐ Certified copies of the priority documents have been received in Application No. _____.
 3. ☐ Copies of the certified copies of the priority documents have been received in this national stage application from the International Bureau (PCT Rule 17.2(a)).

* Certified copies not received: _____.

Applicant has THREE MONTHS FROM THE "MAILING DATE" of this communication to file a reply complying with the requirements noted below. Failure to timely comply will result in ABANDONMENT of this application.

THIS THREE-MONTH PERIOD IS NOT EXTENDABLE.

5. ☐ A SUBSTITUTE OATH OR DECLARATION must be submitted. Note the attached EXAMINER'S AMENDMENT or NOTICE OF INFORMAL PATENT APPLICATION (PTO-152) which gives reason(s) why the oath or declaration is deficient.
 6. ☐ CORRECTED DRAWINGS (as "replacement sheets") must be submitted.
 - (a) ☐ including changes required by the Notice of Draftsperson's Patent Drawing Review (PTO-948) attached
 - 1) ☐ hereto or 2) ☐ to Paper No./Mail Date _____.
 - (b) ☐ including changes required by the attached Examiner's Amendment / Comment or in the Office action of Paper No./Mail Date _____.
- Identifying indicia such as the application number (see 37 CFR 1.84(c)) should be written on the drawings in the front (not the back) of each sheet. Replacement sheet(s) should be labeled as such in the header according to 37 CFR 1.121(d).**
7. ☐ DEPOSIT OF and/or INFORMATION about the deposit of BIOLOGICAL MATERIAL must be submitted. Note the attached Examiner's comment regarding REQUIREMENT FOR THE DEPOSIT OF BIOLOGICAL MATERIAL.

Attachment(s)

- | | |
|---|--|
| 1. <input checked="" type="checkbox"/> Notice of References Cited (PTO-892) | 5. <input type="checkbox"/> Notice of Informal Patent Application (PTO-152) |
| 2. <input type="checkbox"/> Notice of Draftsperson's Patent Drawing Review (PTO-948) | 6. <input type="checkbox"/> Interview Summary (PTO-413),
Paper No./Mail Date _____. |
| 3. <input type="checkbox"/> Information Disclosure Statements (PTO-1449 or PTO/SB/08),
Paper No./Mail Date _____ | 7. <input checked="" type="checkbox"/> Examiner's Amendment/Comment |
| 4. <input type="checkbox"/> Examiner's Comment Regarding Requirement for Deposit
of Biological Material | 8. <input checked="" type="checkbox"/> Examiner's Statement of Reasons for Allowance |
| | 9. <input type="checkbox"/> Other _____. |

EXAMINER'S AMENDMENT

1. An examiner's amendment to the record appears below. Should the changes and/or additions be unacceptable to applicant, an amendment may be filed as provided by 37 CFR 1.312. To ensure consideration of such an amendment, it **MUST** be submitted no later than the payment of the issue fee.

Authorization for this examiner's amendment was given in a telephone interview with **Mark A. Kupanoff (tel. 408 720-8300) on February 7, 2004** (please see Claims 12, 13 and 14 for the same wording).

Claim 11 please inset the symbol of “%” between “10-90” and “by”

DETAILED ACTION

2. Applicants' amendment filed on December 6, 2004 was received. Only parent Claim 1 was amended, and no new claim was canceled or added. To be more specific, **Claim 1** was amended to incorporate the limitation as “the solder material interconnecting the non-fusible particles to form a plurality of columnar structures within the phase change polymer”. The examiner confirms the claim support for such an amendment on **page 6** at paragraph 19 and **page 7** at paragraph 21. **Claims 1-4, 6-14 and 16-17 are pending now.** An action follows.

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Claim rejections under Office Action filed on September 3, 2004 are now removed for the reasons given in paragraphs 3-9 thereafter.

Allowable Subject Matter

3. Claims 1-4, 6-14 and 16-17 are allowed.
4. The following is an examiner's statement of reasons for allowance: The above claims 1-4, 6-14 and 16-17 are allowed over the closest references:
5. *The limitation of amended parent Claim 1 of present invention relates to a thermal interface material comprising a phase change polymer; a solder material having a melting temperature approximately between 100 and 250° C; and a plurality of thermally conductive non-fusible particles, the solder material interconnecting the non-fusible particles to form a plurality of columnar structures within the phase change polymer. See other limitations of dependent Claims 2-4, 6-14 and 16-17.*
6. In view of the Applicants' amendment, parent **Claim 1** of present invention was amended to incorporate the specific architect limitation as "the solder material interconnecting the non-fusible particles to form a plurality of columnar structures within the phase change polymer". It is noted that present invention relates to a thermal interface material comprising (A) a phase

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change polymer, (B) a solder material having a melting temperature approximately between 100 and 250° C, and (C) a plurality of thermally **conductive non-fusible particles**. It is also noted that such a columnar architect is an unusual arrangement in the art of making a thermal interface material.

7. With respect to **103 rejections** for the original set of **Claims 1-4, 6-14 and 16-17**, the primary reference **Nguyen** only discloses a thermal interface material composition comprising (A) rubber, (B) a phase change material such as paraffin waxes or polymers waxes, or mixture thereof, and (C) at least one thermally conductive **filler selected from (c-1) as alloys, silver, aluminum or copper and (c-2) as boron nitride, a carbon fiber or a metal coated carbon fiber.** Both thermal conductive fillers, (c-1) and (c-2), are shown to be used together as shown in Table 1. However, Nguyen is silent of the alloy in (c-1) is the claimed solder since the claimed solder is always an alloy, but an alloy may not necessarily be related to the claimed solder. Additionally, Nguyen is silent of the solder material interconnecting the non-fusible particles to form a plurality of columnar structures within the phase change polymer.

As pointed out by the Applicants on pages 7-8 of Remarks, the secondary reference **Nelson** only discloses that a filler containing a liquid metal such as gallium, mercury, or a compound containing gallium or mercury can be used (column 5, line 48-53). **Such liquid metals are not solder.** Nelson makes no mention of the solder material interconnecting the non-fusible particles to form a plurality of columnar structures within the phase change polymer.

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8. With respect to other **103 rejections** for the original set of **Claims 1-4, 6-14 and 16-17**, the primary reference **Salyer** only discloses that a **thermal energy storage composite** comprises (A) a phase change material such as polyethylene wax, and (B) **flame-resistant fillers**. **Salyer** further discloses the flame-resistant fillers (B) can be selected from antimony oxide, a blend of **pentaerythritol**/monoammonium phosphate, and the mixture thereof. **Salyer** furthermore discloses that such a composite is useful as a fireretardant or **a phase change material**. In summary, **Salyer** is silent of the solder material interconnecting the non-fusible particles to form a plurality of columnar structures within the phase change polymer.

As discussed in the first set of 103 rejection, none of the two secondary references, **Nguyen** and **Nelson**, has taught or fairly suggested the solder material interconnecting the non-fusible particles to form a plurality of columnar structures within the phase change polymer.

Additionally, the present invention has shown in examples along with some comparative examples for making a thermal interface material by the solder material interconnecting the non-fusible particles to form a plurality of columnar structures within the phase change polymer (see pages 6-11 along with its **Figures 1-5**). Therefore, all the above-mentioned references, in combination or alone, does not teach or fairly suggest the limitations of present invention.

9. After further examination and search, the examiner found the following prior art did not teach the claimed limitation:

US Patent No. 6,365,973 B1 to Koning only discloses the preparation of a **filled solder material** comprising **a solder material having a plurality of coated filler particles disposed therein**, wherein said coated filler particles alter the coefficient of thermal expansion of the filled solder material (abstract, line 1-4; column 3, line 34-47). It is noted that some type of architect for solder composite was disclosed in Figures 1-4. Koning does not teach or fairly suggest making a thermal interface material by the solder material interconnecting the non-fusible particles to form a plurality of columnar structures within the phase change polymer.

US Patent No. 5,062,896 to Huang et al. only discloses the preparation of a **solder/polymer composite paste interconnection material** having a low reflow temperature to form electrical contacts having good bonding strength and low contact resistance (abstract, line 1-4; column 3, line 34-47). It is noted that the paste comprises a major proportion of a **meltable metal alloy powder filler**, a minor proportion of a solution of **a temperatureable thermoplastic polymer** having a softening temperature above the melting point of the metal powder filler, and a minor proportion of a **eutectic alloy powder filler** (abstract, line 5-18). Huang does not teach or fairly suggest making a thermal interface material by the solder material interconnecting the non-fusible particles to form a plurality of columnar structures within the phase change polymer.

10. The two key issues, regarding (A) a thermal interface material comprising a phase change polymer; a solder material having a melting temperature approximately between 100 and 250° C; and a plurality of thermally conductive non-fusible particles, (B) the solder material

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interconnecting the non-fusible particles to form a plurality of columnar structures within the phase change polymer, cannot be overcome by any or the combination of the above references, therefore, the present invention is novel.

11. As of the date of this office action, the examiner has not located or identified any reference that can be used singularly or in combination with another reference including the above references to render the present invention anticipated or obvious to one of the ordinary skill in the art. Therefore, the independent and parent **Claim 1** is allowed for the reason listed above. Since the prior art of record fails to teach the present invention, the remaining pending **Claims 2-4, 6-14 and 16-17** are passed to issue.

12. Any inquiry concerning this communication or earlier communication from the examiner should be directed to Henry S. Hu whose telephone number is (571) 272-1103. The examiner can be reached on Monday through Friday from 9:00 AM –5:00 PM.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, David Wu, can be reached on (571) 272-1114. The fax number for the organization where this application or proceeding is assigned is (703) 872-9306 for all regular communications.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications

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may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see <http://pair-direct.uspto.gov>. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free).



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Patent Examiner, au 1713, USPTO

February 7, 2005



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